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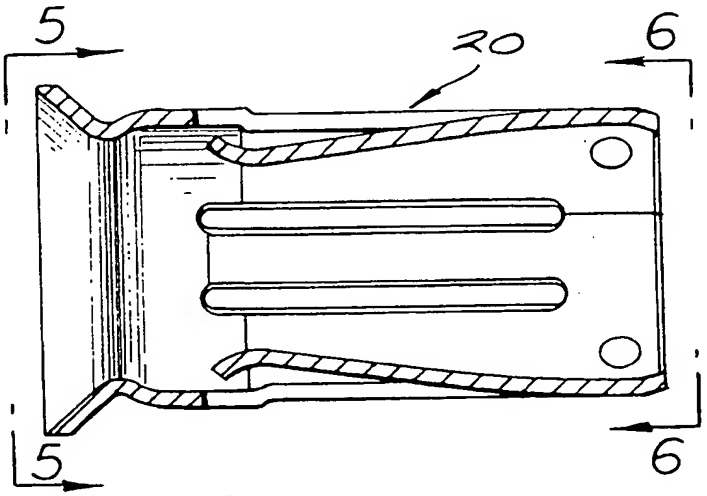
(54) Closed entry socket contact assembly.

(57) A high reliability socket contact assembly is provided, of the type that has a seamless exterior, which has tines with closely spaced initial and final points of pin contact engagement, and which has a closed entry region limiting the size of pin contacts that can be inserted, which can be constructed at low cost. The assembly includes a seamless barrel (12, Figure 3) having a cylindrical cavity (16) extending into its front end, and a clip (20) formed of sheet metal rolled into a tube and lying in the cavity. The clip has a rearward portion (32), tines (42a-42d) extending forwardly from the rearward portion and having free forward tips, and a forward portion. The tips (56) of the tines have radially inner edges (60) lying on a first imaginary circle, and the forward portion of the barrel forms a closed entry region (72) having an inside diameter no greater than the diameter of the first imaginary circle, to prevent entry of pins of a diameter that could damage the tines. In one barrel (Fig. 3), the forward barrel portion has a flared front part (80), with the narrowest part of the flare forming the closed end region. In another clip, (Figure 9) the sheet metal forming the clip is thinner at the tines than at the forward portion (146) lying forward of the tines.

FIG. 4



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This invention relates to socket contact assemblies and relates more specifically to so-called closed entry socket contact assemblies and methods of constructing such assemblies.

High reliability connectors, such as those used in defence applications, generally use socket contact assemblies with seamless exteriors. A common type of socket assembly, such as shown in Figure 1 of the accompanying drawings, includes a solid body with a cavity formed by machining or impact extrusion to form a solid body with a tubular front. Slots are machined in the tubular front to form forwardly extending tines which are crimped (permanently bent) so that their front ends engage a pin contact entering the cavity. A hood is installed around the body to protect the tines and to form a closed entry region that limits the size of pin contacts that can enter between the tines. While such a closed entry socket assembly is reliable, it is expensive to manufacture.

Another known type of seamless socket as shown in Figure 2 of the accompanying drawings, includes solid body with a cylindrical cavity, and a clip formed of rolled sheet metal installed in the cavity. The clip has rearwardly extending tines, and the front of the clip forms a closed entry region. While this closed entry socket assembly can be manufactured at low cost, it has the disadvantage that there is a long distance (Y) between the initial and final points of contact of the tines with a pin contact. Connectors used in defence applications generally must has a short distance between the initial and final points of contact.

It should be noted that there are many types of very low cost socket contacts formed entirely of rolled or folded pieces of sheet metal without any seamless tube around them. However, such metal contacts are subject to damage during handling, between the time they are initially manufactured and the time they are shipped to a customer and installed by the customer in a connector housing. A socket contact assembly having a seamless exterior, a protected spring clip therein with initial and final points of contact that are closed together, a closed entry region at the opening to the cavity and capable of being constructed at low cost would be of considerable value.

According to the present invention there is provided a socket contact assembly comprising an electrically conductive seamless barrel having a wire-terminating rear portion and having a front portion with a front end and with walls forming a cavity that is open at the front end characterised in that the assembly comprises a clip formed of sheet metal rolled into a tubular shape about an axis and lying in the cavity, the clip having a rearward portion, a plurality of tines extending forwardly from the rearward portion with the tines having free forward tips, and a forward portion lying forward of the tine tips, in that each tine has a middle part extending primarily forward but with a radially inward-forward directional component, and has a forward part extending with a radially outward-forward directional component and ending in the tip which has radially inner and outer edges the inner edges lying on a first imaginary circle centred on the axis, in that the clip forward portion forms a closed entry region that has an inside diameter no greater than first imaginary circle, and in that the barrel cavity walls being seamless and lying around the clip forward portion prevent expansion of the closed entry region and protect the clip during handling of the contact assembly with the clip pressing against the cavity walls to securely hold the clip in the cavity.

In accordance with one embodiment of the present invention, a socket contact assembly suitable for high reliability applications is provided, which has a seamless exterior, closed entry region, and closely spaced initial and final points of contact, which can be constructed at low cost. The assembly includes a seamless barrel having a wire-terminating rear portion, and having a front portion with a largely cylindrical cavity open at the front end of the barrel. A clip that lies in the cavity, is formed of sheet metal rolled into a tubular shape and having an axis coincident with the axis of the cavity. The clip has a plurality of tines extending from a rearward clip portion in a forward direction but at a radially-inward incline, with the front parts of the tines having a reverse bend. The tips of the tines have radially inner edges lying on a first imaginary circle. The forward portion of the clip has a closed entry region having an inside diameter no greater than the diameter of the first imaginary circle containing the inside edges of the tine tips.

In one clip construction, the front portion of the clip has a flared forward part, with the flare extending to a smaller diameter than the rest of the clip. In another clip construction, a thick piece of sheet metal from which the clip is formed, has a reduced thickness at the tines, so the thick front portion of the clip can be substantially cylindrical and still have a small inside diameter forming a closed entry region.

By way of example the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a sectional side view of a socket contact assembly constructed in accordance with the prior art;

Figure 2 is a partial sectional view of another socket contact assembly constructed in accordance with the prior art;

Figure 3 is a partial sectional view of a contact assembly constructed in accordance with the present invention, and showing a square ended pin contact partially installed therein;

Figure 4 is a sectional side view of the clip of the socket contact assembly of Figure 3;

Figure 5 is a front elevation view taken on the line 5-5 of Figure 4;

Figure 6 is a rear elevation view taken on the line

6-6 of Figure 4;

Figure 7 is a partial sectional view of a connector which holds socket contact assemblies of the the shown in Figure 3;

Figure 8 is a plan view of a piece of sheet metal from which the clip of Figure 4 is formed;

Figure 9 is a partial sectional view of a socket contact assembly constructed in accordance with another embodiment of the invention;

Figure 10 is a plan view of a piece of sheet metal from which the clip of the socket contact assembly of Figure 9 is formed;

Figure 11 is a front elevation view of the socket contact assembly of Figure 9; and

Figure 12 is an enlarged sectional view of a portion of the socket contact assembly of Figure 9.

Referring to the drawings, Figure 1 illustrates a prior art high reliability socket contact assembly A which includes a socket body B having a rearward portion C with a hole that receives a conductor D of a wire and is crimped at E to hold the conductor in place. The front portion F of the body has a cylindrical cavity G and has slots H that divide the front portion into individual tines J. The tines are crimped or permanently bent so that their front ends are closer together than their rear ends in order to firmly engage a pin contact K. A protective hood L press-fitted on to the front portion of the socket body, has a flare or chamfer M which forms a restricted entry region to prevent the entry of large diameter pin contacts which could press against the tips N of the tines and damage them. When a test pin contact with a square end indicated at O is inserted, it engages the tines at an initial point of contact P. Further insertion of the imaginary square-ended pin contact K results in outward deflection of the contacts and engagement of the pin at a point Q. The initial and final engagement points P, Q are closely spaced, which is highly desirable. The length of the pin contacts is preferably as short as possible to avoid damage to them. However, a considerable length of contact is required because the depth of pin insertion varies with many factors such as how tight a coupling nut connecting two connectors together is turned. As a result, it is important that the points P, Q lie close together. While the socket assembly A is highly reliable, it is expensive to manufacture because of the cost of cutting the slots H, heat treating the front portion F of the body B for springiness of the tines and annealing the rearward portion C to permit crimping thereof to a wire, and forming a hood L with a seamless exterior. Both the hood and socket body B must be seamless to avoid damage to them during handling, between the time of manufacturer and the time when a customer installs the contact assembly in a connector housing.

Figure 2 of the drawings illustrates another prior art socket contact assembly R, which also includes a seamless socket body S that holds a spring clip T. The spring clip is formed of a rolled piece of sheet metal with slots U forming tines extending in a rearward direction. The forward end W of the clip serves as a closed entry region that limits the size of contact pins that can be inserted. An important disadvantage of this type of assembly is that the initial point of contact X with a square ended pin O, is spaced a considerable distance Y from the final point of contact Z, which makes this assembly unacceptable in many applications. Otherwise, this assembly has many advantages, because the socket body with a simple cylindrical cavity can be constructed at low cost, and because the rolled sheet metal clip T can also be constructed and installed at low cost.

Referring now to Figure 3 of the drawings, this illustrates a portion of a socket contact assembly 10 of the present invention. The assembly includes a seamless body or barrel 12 having a forward portion 14 with a largely cylindrical cavity 16 open to the front end 18 of the barrel. The assembly also includes a spring clip 20 installed in the cavity of the barrel, and designed to make contact with a pin contact 22 of a typical type having a well rounded end, or even a test contact with a square end indicated at 24. The barrel 12 is similar to those of the prior art, in that it is formed of solid metal stock such as a metal rod, with the cavity 16 formed by machining or impact extrusion to form a sturdy seamless barrel that can be handled without damaging the spring clip. It is noted that the barrel has a wire terminating rear portion 26 which may be similar to those of the prior art, such as shown at C in Figure 1, for receiving and crimping around a wire conductor or which may be of another type.

The barrel 12 and spring clip 20 are coaxial at an axis 30. The clip has a rearward portion 32 which presses firmly against the walls of the barrel cavity 16 (at its dimples 102), a middle portion 34 that extends forwardly in the direction of arrow F from the rearward portion, and a forward portion 36 that also presses firmly against the inside of the cavity. The middle portion 34 of the clip has a plurality of slots 40 that divide it into four tines 42a-42d.

Each tine has a rear part 50 supported on the rearward portion 32 of the clip. Each tine also has a middle part 52 that has been bent or crimped to extend at a forward-inward incline, that is with a radially inward (toward axis 30)-forward directional component, so that progressively forward locations are progressively closer to the axis 30. Each tine also has a forward part 54 extending at a forward-outward incline, that is, with a radially outward-forward directional component, and ending in a tip 56. The tip 56 has radially inner and outer edges 60,62.

The point 64 where the radially inner surface of the middle and forward parts 52,54 meet, is the point where the tine engages the fully inserted pin contact 22. A point 66 along the forward part 54 of the tine, is the point where a square end 24 of a test contact will

initially engage the tine. The distance 70 between the initial and final points of engagement, is relatively small, such as less than 1/4th the diameter of the pin contact 22, and therefore meets the requirements for such distance as previously discussed.

The forward portion 36 of the clip forms a closed entry region 72 that limits the size (diameter) of pin contact 22 that can be inserted into the socket assembly. The closed entry region lies on an imaginary circle of a diameter 74, which prevents the passage of pin contacts of a diameter greater than the diameter 74. If the reduced diameter closed entry region 74 were not provided, then a pin contact with a substantially square end and of a relatively large diameter could be inserted into the assembly and engage the inner edges 60 of the tines. Then, instead of deflecting the tines outwardly, the pin contact would crumple the tines in a column-like collapse, and thereby damage the contact assembly. The radially inner edges 60 of the tips 56 lie on an imaginary circle of a diameter 76. The diameter 74 of the closed entry region 72 should be as small as, and preferably smaller than the diameter 76 of a circle on which the tip inner edges 60 lie, to protect the tines.

The forward portion 36 of the clip includes a flared front part 80 with radially inner and outer surfaces 82, 84 that are both tapered at a forward-outward incline (i.e. in a radially inward-rearward direction). Both inner and outer surfaces 82,84 are tapered due to the fact that the clip is formed from sheet metal so its opposite faces are parallel. The rear end of the flared front part 80 forms the closed entry region 72. The clip forward portion also includes a middle part 86 extending rearwardly from the region 72 and tapered at a forward-inward incline (i.e. in a radially outward-rearward direction) at both its inner and outer surfaces 90,92. The forward portion also includes a rear part 94 which is substantially cylindrical and which presses firmly against the inner walls of the barrel cavity 16.

The flared front part 80 provides a good guide surface for guiding a pin contact through the closed entry regions 72. The change in diameter along the flare is a plurality of times greater than the thickness of the sheet metal. The closed entry region 72 smoothly guides the contacts into the rest of the clip, because it has a smoothly rounded surface (with a radius of curvature greater than the thickness of the sheet metal) where the front and middle parts 80,86 meet. It is noted that the outside surface of the clip at the point 96 directly outside the closed entry region 72, has a smaller diameter than most of the rest of the clip and of the walls of the cavity 16. The front of the barrel has a tapered surface 100 that matches the taper of the clip flared front part 80 to securely back it up.

The rearward portion 32 of the clip has four dimples 102 that project radially outwardly from surrounding areas of the rearward portion, and which press firmly against the walls of the cavity. The clip is held in place in the cavity at its rearward portion by the four dimples 102, and at its forward portion 36 by the rear part 94 thereof which presses firmly against the walls of the cavity. Additional holding power can be provided by radially inwardly deforming the barrel at the location 110, to form an inward projection 112 of the cavity walls. The projection 112 lies around the inwardly projecting bump or closed end region 72 of the clip where the outer surface 96 has a smaller diameter than that of the walls of the cavity without the projection 112. The projection 112 can be in the form of a plurality of depressions, or alternately can be in the form of a continual ring-shaped depression around the circumference of the barrel.

Figure 8 illustrates a flat piece of sheet metal 114 which can be rolled up to form the clip 20 of Figures 3 and 4. The flat piece of sheet metal has a largely constant width along the rearward and middle portions 32,34, but the forward portion 36 has a greater width, at least along the flared front part 80 where the sheet has a progressively greater width at progressively more forward locations in the direction F. The sheet metal is initially cut from a larger sheet. The slots 40 are cut in the sheet metal to extend in forward and rearward directions F and R, and lancing cuts 116 are formed at the forward end of locations between adjacent pairs of slots, to form the tines 42a-42d. Also, depressions are formed to leave the dimples 102. Then the piece of sheet metal is rolled to form a clip. As shown in Figure 6, before the clip is installed, there is a gap 118 at the opposite sides of the rolled sheet metal. However, the width of the sheet metal is closely controlled with respect to the diameter of the barrel cavity so that as the clip is inserted into the cavity the gap 116 is closed at least at the rear part 94 of the front portion. As a result, the rear part 94 presses firmly against the walls of the cavity to hold the clip in place (in addition to the pressure of the dimples against the cavity walls).

After the clips are installed in the barrels, the resulting socket contact assemblies are placed in a container and shipped to a customer. The customer then loads the contact assemblies into an insulative housing such as shown at 120 in Figure 7. Where the wire termination rearward portions 26 of the barrels are to be crimped to conductors as in Figure 1, the conductors will be first inserted and crimped in place before the contact assemblies are inserted into holes 121 of the housing 120 of a connector 122. The contact assemblies can encounter considerable handling when they are removed from a shipping container, loaded in apparatus for terminating their rearward portions, and inserted into the connector housing. The fact that the barrel is seamless and has thick walls, and completely surrounds the clip 20, results in high reliability that the installed contact assembly will function well if it has been initially manufactured without

defects.

In one specific contact assembly of the type illustrated in Figure 3 that has been designed, the barrel has an outer diameter of 0.076 inch, the clip is designed to accept pin contacts of a diameter of 0.040 inch, and the distance 70 between the initial and final points of contact is 0.006 inch. The clip is heavily gold plated, while the barrel is only thinly gold plated. The gold plating of the barrel makes it difficult to inwardly deform the front end of the barrel to use that as a closed entry region, as such deformation of a small diameter barrel could crack the plating.

While the contact assembly of Figure 3 is of relatively simple design, and can be manufactured at low cost once tooling is made, it tends to require relatively costly tooling to roll the piece of sheet metal 114 because of the fact that its front part is of tapered width. Figures 9-11 illustrate another socket contact assembly according to the invention which can be constructed with lower cost tooling.

The contact assembly 130 of Figure 9 has a seamless barrel 132 formed by machining or impact extrusion of solid metal stock, and has a clip 134 lying in a cavity 136 formed in the forward portion 138 of the barrel. The clip is formed of a piece of sheet metal, but the tines 140 are of a smaller thickness 142 than the rest of the sheet metal and specifically are less than the thickness 144 of a forward portion 146 of the clip. The greater thickness 144 of the forward portion, results in the radially inner surface 150 (radially means with respect to the axis 152 of the barrel and clip) having a diameter 153 equal to or (preferably) smaller than an imaginary circle on which lie the radially inner edges 154 of the tine tips 156. The rearward parts 160 of the tines have the same radially outer diameter as the adjacent rearward portion 162 and of the forward portion 146. However, the tine rearward parts 160 have inner surfaces 164 of greater diameter than the clip rearward portion 162. This results in the tines extending at a greater angle or incline from the axis 152 for a contact point 166 of given initial inside diameter (before a pin is inserted). The middle and forward parts 170, 172 of the tines are similar to those of the clip of Figure 3. The extreme front end of the clip at 174 is preferably bevelled. Although the bevelled portion 174 is not bevelled over as great a difference in diameter as the clip of Figure 3, the clip 134 of Figure 9 can be constructed with simpler tooling.

Figure 10 illustrates a piece of flat sheet material 180 from which the clip of Figure 9 can be constructed. The piece of sheet metal can be cut as a rectangle from a larger sheet. Then slots 182 are formed in the sheet, with slot-like indentations 184 at the opposite sides of the sheet. A next step is to apply a punch having the shape indicated at 186, to areas that include the tines 140a-140d. The punch is pressed with sufficient force to reduce the thickness of a corresponding area 190 of the sheet, with most of the area to form a tine. An initially thick sheet such as of 0.006 inch may be used, with the punch decreasing the thickness to perhaps 0.004 inch. After the punch has been applied, areas such as 192 on either side of the tine, which have been extended by the punching operation, are trimmed away. The next step is to lance cut the sheet at the locations 194 to form the tine ends. The next step is to bend or crimp the tines such as 140a to the configurations shown in Figure 9. Then, the piece of sheet metal 180 is rolled into a tubular shape.

The rolling of the piece of sheet metal 180 (i.e. bending substantially all portions about an axis, as opposed to making a few sharp 90 bends into a square cross-section) can be relatively easily accomplished because its forward and rearward ends are of substantially the same width. After rolling, the clip is installed in the cavity of the barrel 132. The width of the piece of sheet metal is closely controlled so when rolled and inserted, the rearward portion 162 and forward portion 146 of the clip press firmly against the walls of the barrel cavity to hold the clip in place. As shown in Figure 11, the opposite sides of the sheet metal abut one another at the location 196.

Figure 12 illustrates a portion of the spring clip of Figure 9. The clip may be formed of sheet metal most of which has a thickness 200 of 0.006 inch, and with tines 140 of a thickness 202 of 0.004 inch. The radially inner edge 154 of the tine tip lies radially outward of the inner face 150 of the thick forward clip portion 146, by a distance 204 which is a minimum of 0.001 inch (at least 2% of the inside diameter 153 of the closed entry region). The outer edge 206 of the tine tip can deflect outwardly by a distance 210 of 0.004 inch. The contact point 166 can be deflected outwardly by up to 0.005 inch (0.001 more than distance 210) before the tine is permanently set. The clip is designed to receive pin contacts of a nominal diameter of 0.040 inch, and a maximum diameter of 0.041 inch. The closed entry region (150 in Figure 9) has a diameter 152 of 0.044 inch with a tolerance of .001 inch.

Claims

1. A socket contact assembly comprising an electrically conductive seamless barrel having a wire-terminating rear portion and having a front portion with a front end and with walls forming a cavity that is open at the front end characterised in that the assembly comprises a clip (20,134) formed of sheet metal (114,180) rolled into a tubular shape about an axis and lying in the cavity (16,136), the clip having a rearward portion (32,162), a plurality of tines (42,140) extending forwardly from the rearward portion with the tines having free forward tips (56), and a forward portion (36,146) lying forward of the tine tips, in that each tine

(42,140) has a middle part (52,170) extending primarily forward but with a radially inward-forward directional component, and has a forward part (54,170) extending with a radially outward-forward directional component and ending in the tip (56,156) which has radially inner (60) and outer (62) edges the inner edges (60) lying on a first imaginary circle centred on the axis (30,152), in that the clip forward (36,144) portion forms a closed entry region (74,153) that has an inside diameter no greater than first imaginary circle, and in that the barrel cavity walls being seamless and lying around the clip forward portion (36,146) prevent expansion of the closed entry region (74,153) and protect the clip during handling of the contact assembly with the clip (20,134) pressing against the cavity walls to securely hold the clip in the cavity (16,136).

2. A contact assembly as claimed in claim 1, characterised in that the assembly comprises a dielectric housing (120) having a plurality of contact-assembly receiving holes (121), a plurality of additional contact assemblies (10,130) that each includes a barrel (12,132) and a clip (20,134) that are each substantially identical to the first mentioned barrel and clip and with each additional clip lying in one of the additional barrels, each of the contact assemblies (10,130), lying in one of the holes (121) in the housing (120).

3. A contact assembly as claimed in claim 1, characterised in that the sheet metal clip forward portion (36) includes a flared front part (80) with radially inner (82) and outer (84) surfaces that are both tapered in a radially inward-rearward direction, and with the rear end of the flared front part (80) having a smaller inside diameter (74) than the diameter (76) of the first imaginary circle which lies on the tip inner edges (60), the inner surface of the rear end of the flared front part forming the closed entry region (74), the clip forward portion also including a middle part (86) extending rearwardly from the rear end of the flared front part (80) with the middle part having radially inner and outer surfaces that are both tapered in a radially outward-rearward direction.

4. A contact assembly as claimed in claim 3, characterised in that the flared front part (80) of the clip (20) has a front end of greater diameter than any other part of the clip, and the barrel front portion (14) has a tapered front part (100) that matches and abuts the radially outer surface (84) of the clip flared front part (80).

5. A contact assembly as claimed in claim 3 or claim 4, characterised in that the rolled sheet of metal (114) which forms the clip (20) when lying flat before it is rolled, has a largely constant width except at the front part of the front portion (36) where the sheet has a progressively greater width at progressively more forward locations.

6. A contact assembly as claimed in any one of claims 3 to 5, charcterised in that the clip forward portion includes a cylindrical part (94) extending rearward of the middle part (86) and pressing firmly against the cavity walls.

7. A contact assembly as claimed in any of claims 3 to 6, characterised in that the clip forward portion (36) forms a radially inwardly-projecting bump at the intersection of the front (80) and middle (86) parts, the curved bump having a radially inner surface that includes the rear end of the flared front part and in that the barrel (12) and the walls of the cavity (16) are radially inwardly deformed into the radially outer surface of the clip at the inwardly-projecting bump.

8. A contact assembly as claimed in any preceding claim, characterised in that the rearward portion (32) of the clip includes at least three radially outwardly projecting dimples (102) pressing firmly against the walls of the cavity (16).

9. A contact assembly as claimed in claim 1, characterised in that the tine tip outer edges (62) are radially spaced from the cavity wall by a deflection distance (210), and the most radially inner locations on the tines (140), at the intersection of the tine middle (170) and forward (172) parts, lie on an imaginary circle that has an inside diameter which is less than the minimum inside diameter of the closed entry region by no more than one-half D, whereby the largest diameter in this can pass through the closed entry region does not press the tine tip outer edges hard against the cavity wall.

10. A contact assembly as claimed in claim 1, characterised in that the sheet of metal (180) has a smaller thickness at the tines (140) than at the forward portion (146), and most of the radially inner surface (150) of the forward portion lies on an imaginary cylinder and forms the closed entry region (153).

11. A socket contact assembly comprising an elongated seamless metal barrel having an axis, a rear end termination portion, and a front portion having walls forming a substantially cylindrical cavity centred on said axis, the cavity having a front end which is tapered in a radially outwardly-forward direction, characterised in that the

assembly comprises a clip (20) formed of a piece of sheet metal (114) rolled into a tube and having forward (36), rearward (32) and middle portions (34), the clip lying in the barrel cavity (16) and having an axis (30) coaxial with barrel axis (30), in that the clip middle portion (34) has a plurality of tines (42) and a plurality of slots (40) extending primarily parallel to the axis (30) with at least one of the tines formed between a pair of the slots, and with each tine having a free forward end ending in a free tip (56), in that each of the tines has a middle part (52) extending in a radially inward-forward direction and has a forward part (54) extending in a radially outward-forward direction, in that the tips of the tines have radially inner edges (60) and an imaginary circle of a first diameter passes through the inner edges of the tine tips (56) and in that the clip forward portion (54) has a front part (80) flared in a radially outward-forward direction and abutting the barrel tapered front end (100), a middle part (86) extending from the rear end of flared front part (80) in a radially outward-rearward direction, and a close entry region (74) at the intersection of the front and middle parts, the closed entry region (74) having a diameter that is less than the first diameter.

12. A contact assembly as claimed in claim 11, characterised in that the clip forward portion (36) has a substantially cylindrical rear part (94) pressing firmly against the walls of the cavity (16).

13. A contact assembly as claimed in claim 10 or claim 11, characterised in that the piece of sheet metal (114) in a flat unrolled configuration, is formed with the front part thereof tapered in width to have a progressively greater width at progressively more forward locations therealong.

14. A socket contact assembly comprising an elongated seamless metal barrel having an axis, a rear end termination portion, and a front portion having walls forming a substantially cylindrical cavity centred on the axis, characterised in that the assembly comprises a clip (134) formed of a piece of sheet metal (180) rolled into a tube and having forward (146), rearward (162) and middle portions, the clip lying in the barrel cavity (136) and having an axis (152) coaxial with the barrel axis (152), in that the clip middle portion has a plurality of tines (140), and a plurality of slots extending primarily parallel to the axis (152) with at least one of the tines formed between a pair of the slots, and with each tine having a free forward end (172) ending in a free tip (56), in that each of the tines has a middle part (170) extending in a radially inward-forward direction and has a forward part (172) extending in a radially outward-forward direction, in that the tine tips (156) have radially inner and outer edges, with the tip inner edges lying on an imaginary circle of a first diameter and in that the piece of sheet metal (114) has a reduced thickness (202) at the tines, with moat of the clip forward portion (150) having a greater thickness than the tines, and with the radially inner diameter of the forward portion (150) being smaller than the first diameter.

15. A contact assembly as claimed in claim 14, characterised in that the piece of sheet metal (114) has outer and inner faces which respectively form the radially outer and inner surfaces of the clip (134) and in that the tines (140) have rear ends (160) with outer surfaces that are flush with the outer surface of the rearward clip portion (162), and with inner surfaces (164) that are recessed from the inner surface of the rearward clip portion.

16. A method of forming a socket contact assembly, characterised by the steps of forming a cavity in the front end of a metal rod to form a seamless barrel with a cavity, cutting a piece of sheet metal to have a rearward portion, a middle portion and a forward portion, forming a plurality of elongated slots extending in forward and rearward directions in the middle portion, and forming substantially identical tines including cutting front ends of the material between pairs of the slots to form a plurality of tines which are formed with free front tips and with tine rear ends merging with the rearward portion, bending the tines out of the plane of the sheet metal, rolling the sheet into a tubular shape having an axis to form a spring clip, and inserting the clip into the cavity of the barrel with the tine front ends forward of the tine rear ends, characterised in that the step of bending the tines includes bending middle parts of the tines so they extend in a radially inward-forward direction when the piece of sheet metal is rolled, and bending forward parts of the tines to extend in a radially outward-forward direction to the tips, and with radially inner edges of the tips lying on a first imaginary circle of a first diameter and in that the steps of cutting and rolling include forming the forward portion to have a closed entry region with a radially inner surface lying on a circle of a second predetermined diameter that is smaller than the first diameter.

17. A method as claimed in claim 16, characterised in that the step of cutting includes forming the piece of sheet metal so that a forward part of the front portion is tapered in width to have a greater width at progressively more forward locations and in

that the step of rolling includes forming the forward part to form a portion of the tube with a front part that is flared in a radially inward-rearward direction and that has a rear end of the second diameter.

18. A method as claimed in claim 16, characterised by the step of thinning the tines to a thickness less than the thickness of the forward portion, so that the forward portion has a greater thickness than the tines to form the closed entry region.

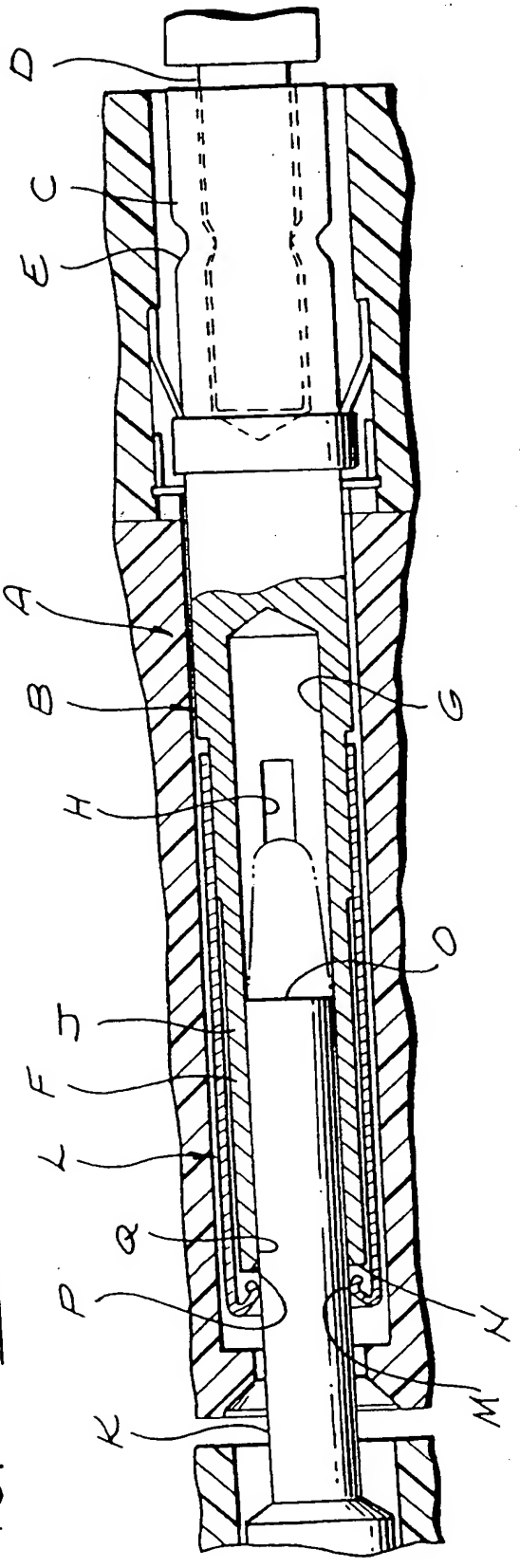


FIG. 1 PRIOR ART

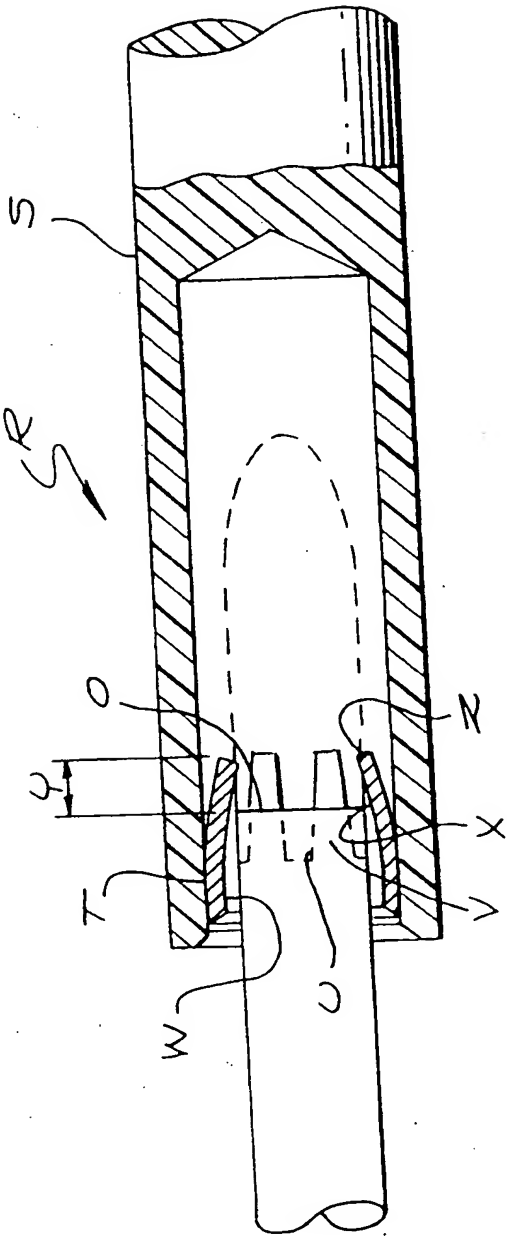


FIG. 2 PRIOR ART

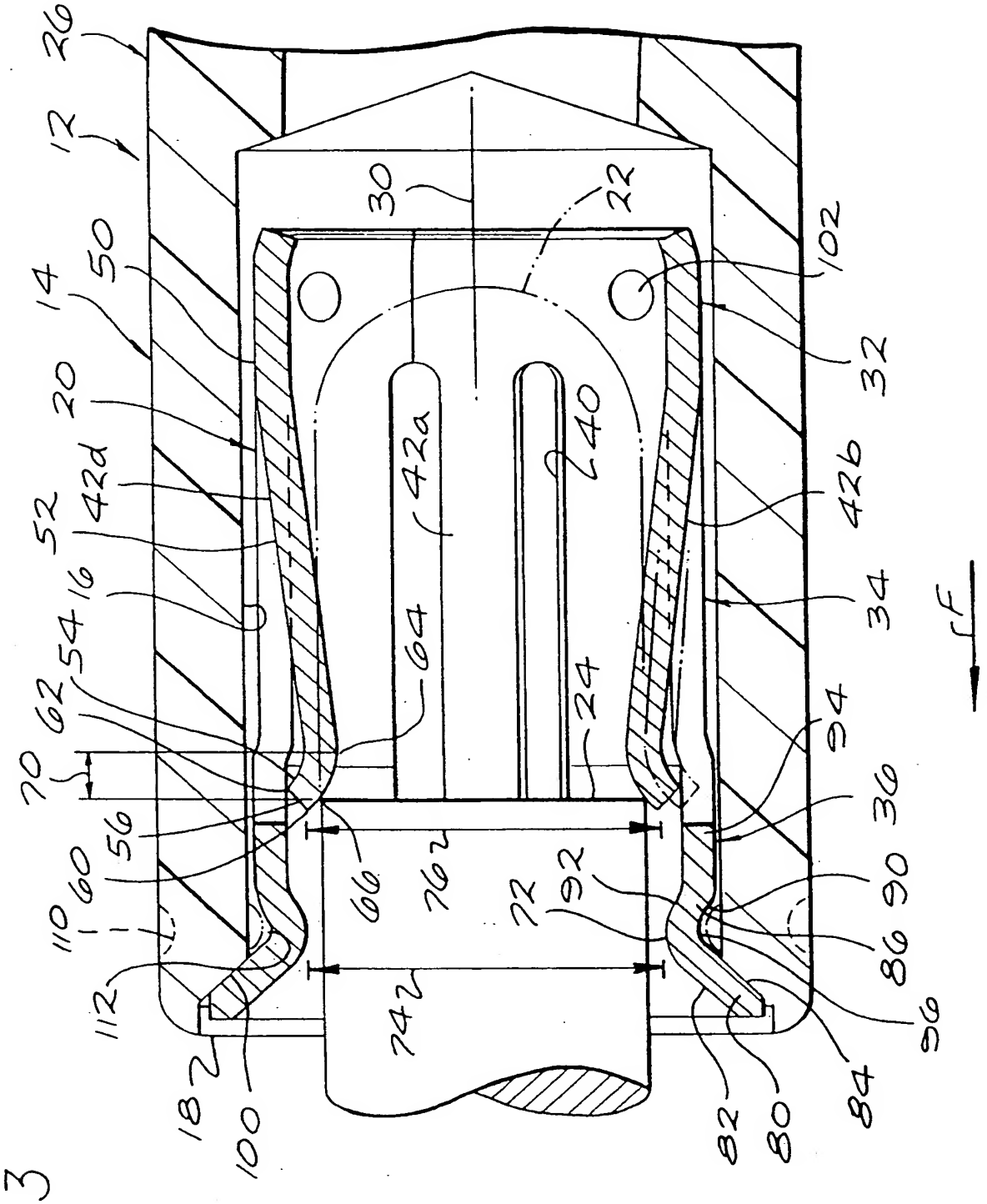


FIG. 3

FIG. 4

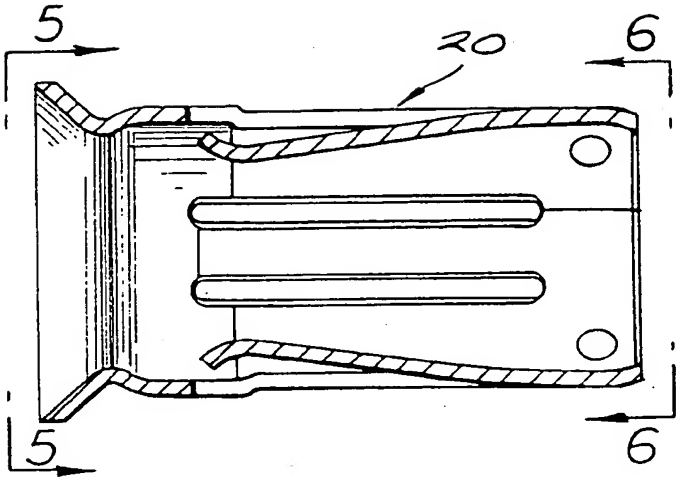


FIG. 5

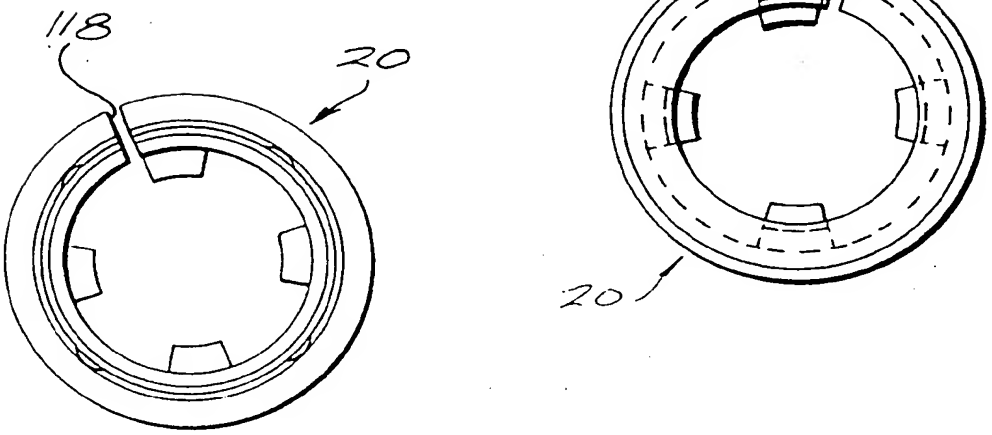


FIG. 6

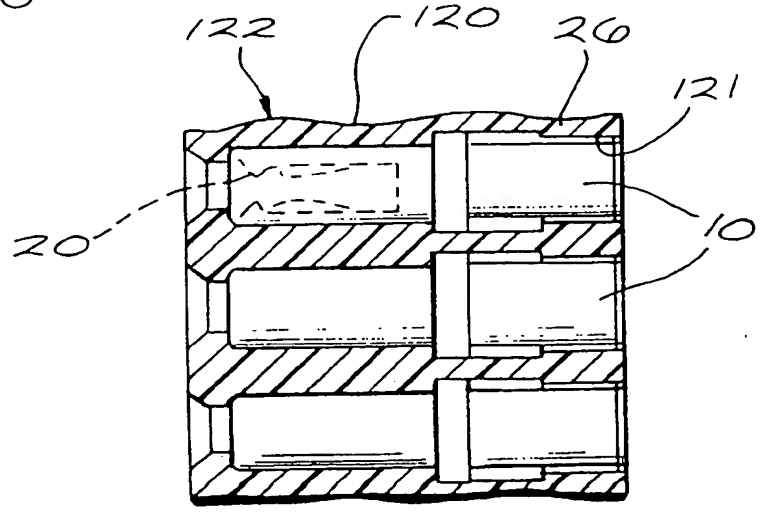
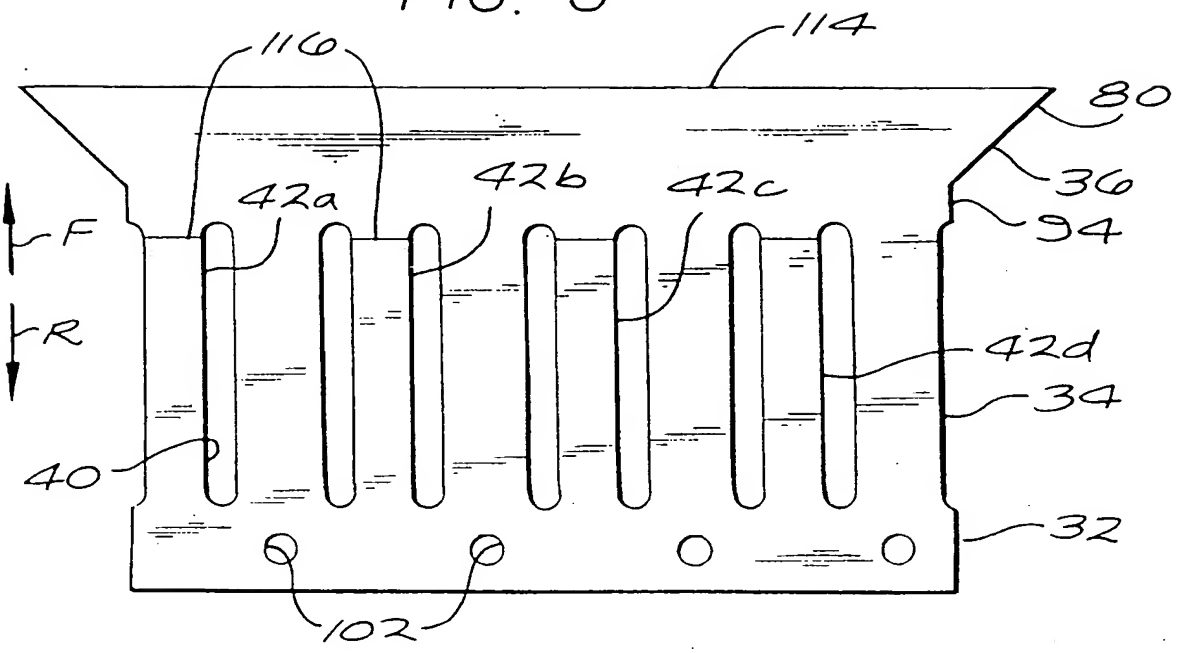


FIG. 7

FIG. 8



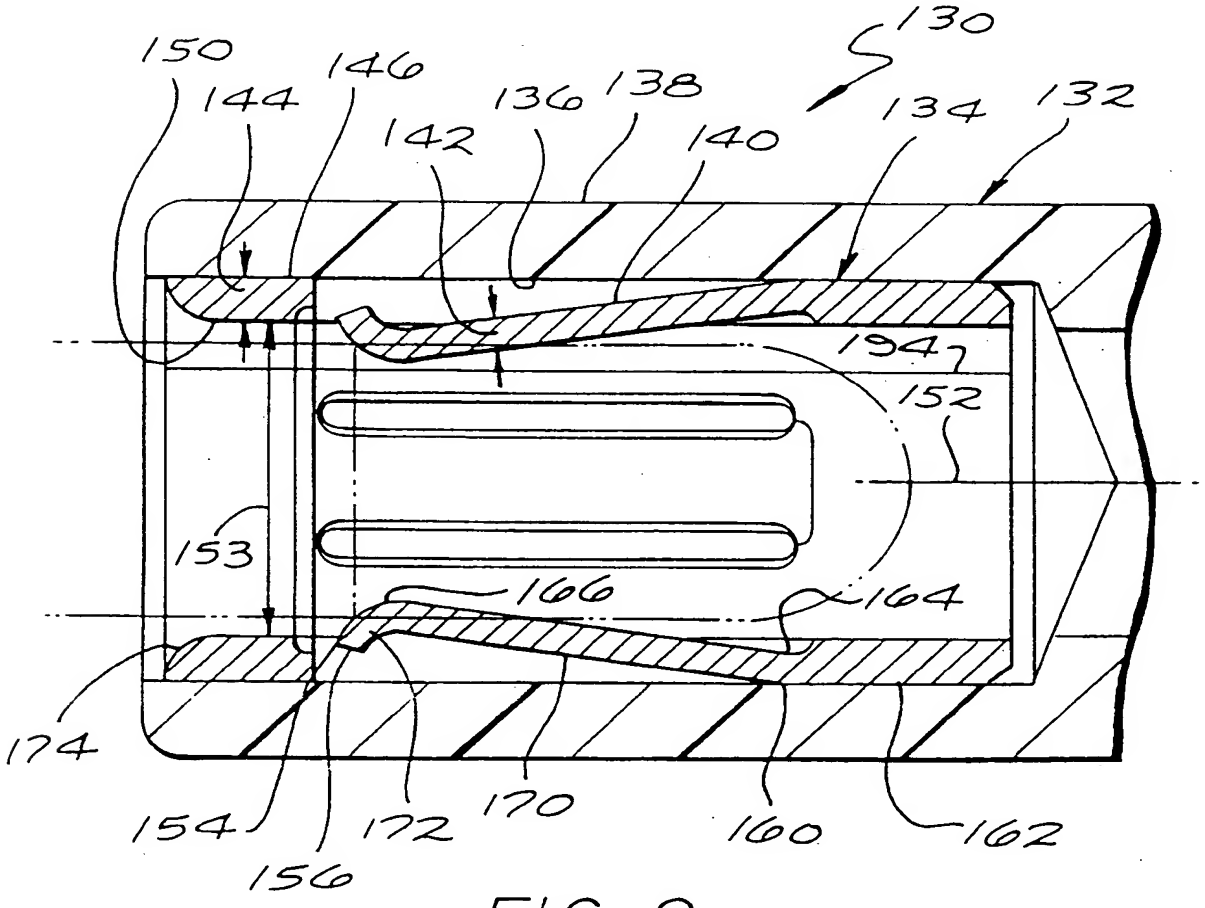


FIG 9

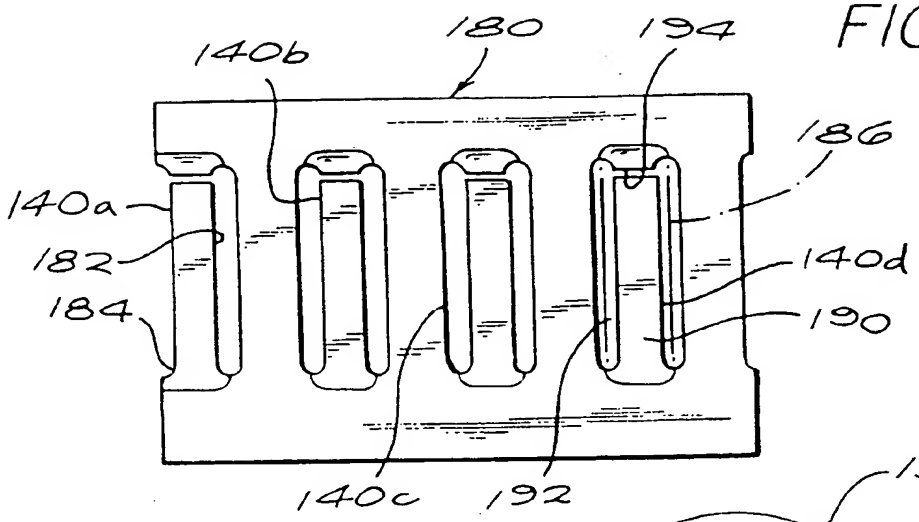


FIG. 10

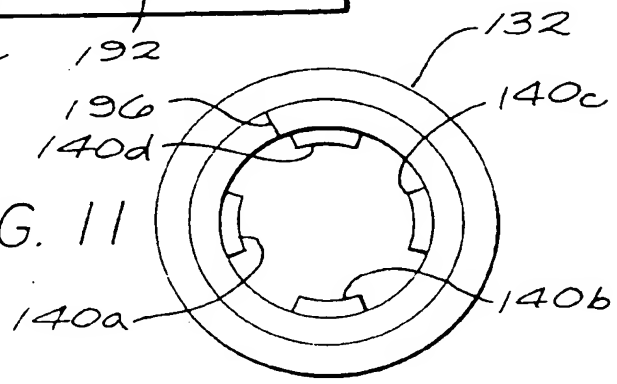


FIG. 11

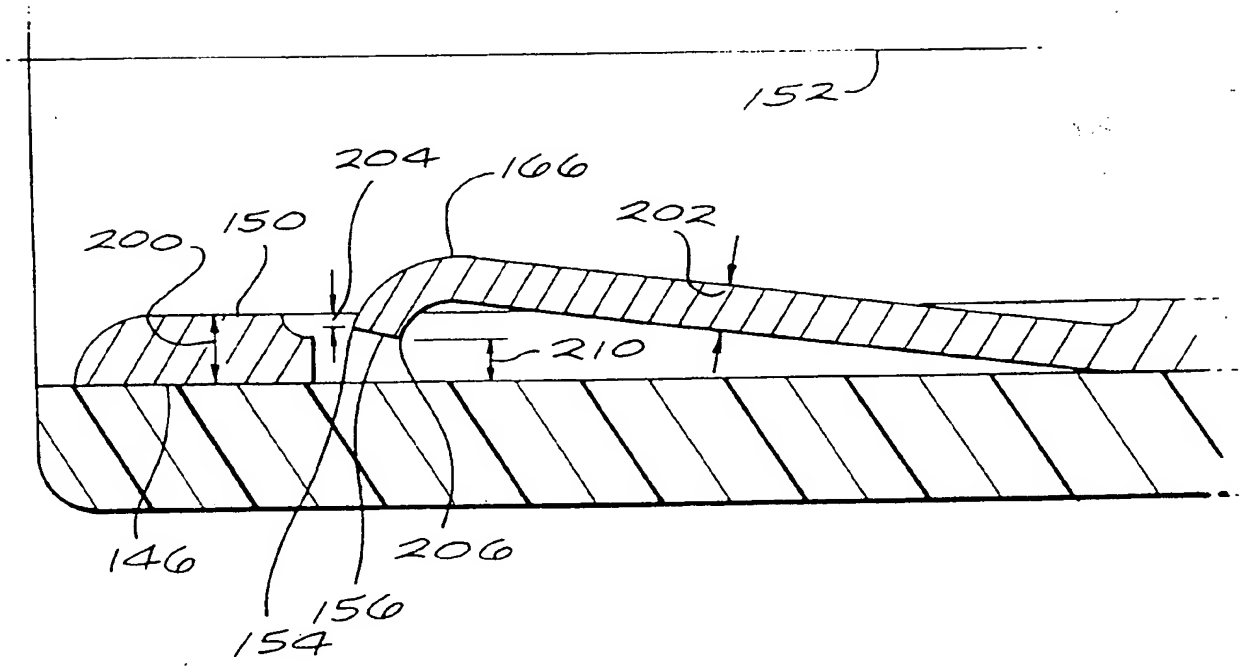


FIG. 12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 7738

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 188 751 (BRINTEC SYSTEMS CORP.) * claims 1-2,9; figures 3-4 *	1	H01R13/187
A	US-A-3 922 057 (LEMKE ET AL.) * figure 2 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04 DECEMBER 1991	Stefano Sibilla

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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